Larix decidua

Larix decidua and other larches in Europe: distribution, habitat, usage and threats

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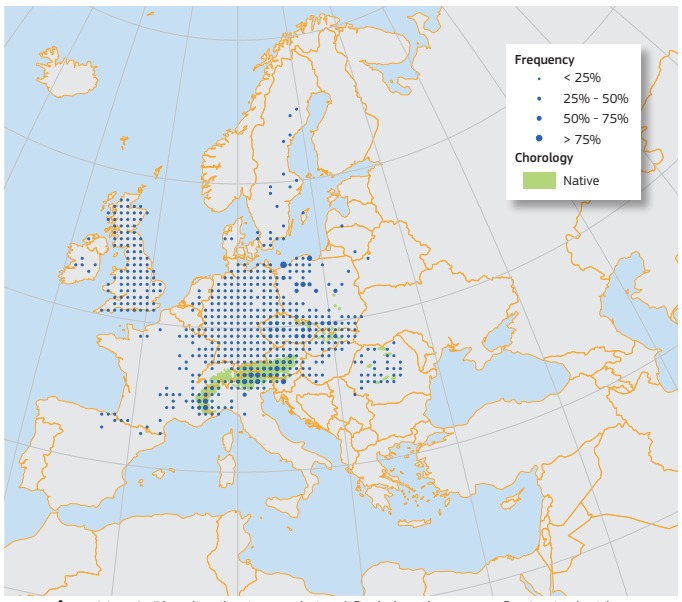
The European larch (*Larix decidua* Mill.) is a pioneer, very long-lived, fast-growing coniferous tree, which occurs in the central and eastern mountains of Europe, forming open forests or pasture woods at the upper tree limits. Larch is the only deciduous conifer in Europe as an adaptation to continental alpine climates. In fact, it is able to tolerate very cold temperatures during winter and, by losing its needles, avoids foliage desiccation. It is a transitional species, colonising open terrain after natural disturbances. It forms pure stands but more often it is found with other alpine tree species, which tend to replace it if no other disturbances occur. Thanks to its adaptability and the durability of its wood, the European larch represents an important silvicultural tree species in the alpine regions, planted even outside its natural ranges. Its wood is largely used for carpentry, furniture and pulp for paper. In lower altitudes or with high precipitation rates, larch is more susceptible to fungal diseases. Outbreaks of insect defoliators, principally caused by the larch bud moth (*Zeiraphera diniana*), can limit tree development, with economic losses in plantations, but they rarely lead to the death of the trees.

The European larch (*Larix decidua* Mill.) is a large deciduous coniferous tree that reaches 45 m, rarely over 50 m, and a lifespan of 600-800 years in optimal conditions[1]. Like other tree species, larches in the highest elevations are more slow-growing and long-living, reaching even more than 1 000 years in age, so making this species suitable for dendrochronology studies[2, 3]. The trunk is **monopodial**, straight or curved at base in slopes, with a diameter of 1-1.5 (2) m and fissured bark from reddish brown to light grey[4]. Young plants are very flexible and are not damaged by avalanches[1]. The needles are clustered in bunches of 20-40, flexible, 1.5-4 cm long and 1 mm wide. The colour is light green and turns yellow in autumn before falling[2]. The larch is a **monoecious unisexual** species: the male cones (5-10 mm) are sulphur yellow, with a reddish margin, hanging on the longer branches; the female cones are pink-red or dark purple when immature and turn a light green with purple margins at maturity. The seed cones are about 2.5 cm long and persist in the plant up to 10 years; when old they turn to a grey colour and fall along with the small branches. The seeds are 4-5 mm long, greyish in colour[5].



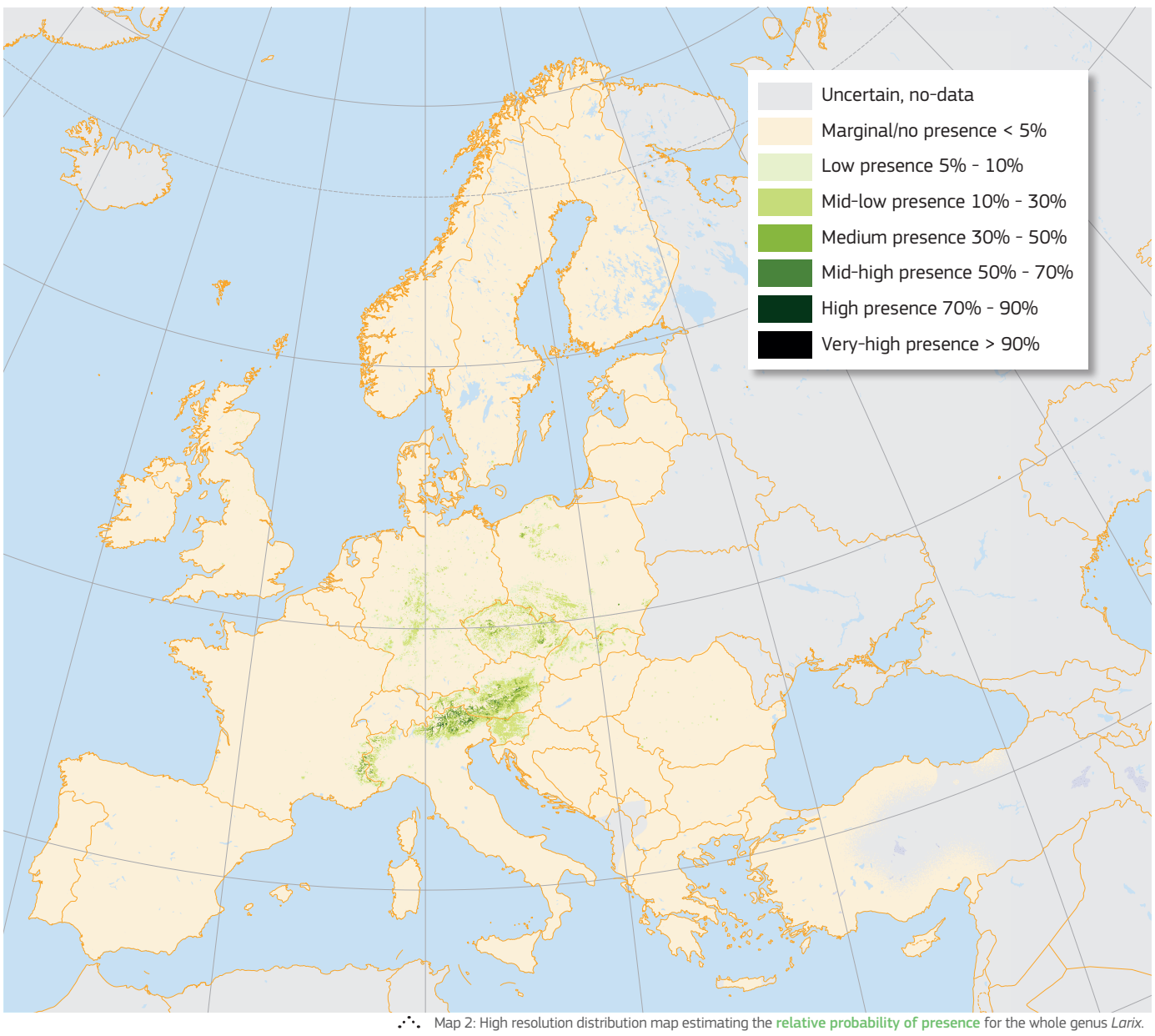
Map 1: Plot distribution and simplified chorology map for *Larix decidua*. Frequency of *Larix decidua* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *L. decidua* is derived after Wagner et al.[41].

Distribution

European larch is discontinuously distributed in the mountains of southern, central and Eastern Europe, from south-eastern France and south-western Italy to eastern Poland and central Romania[6-8]. It has a broad vertical range, forming forests between 180 m (in Poland) to 2 500 m (central Alps, south-western Alps), but reaching very high elevations where it can found in small groups or single trees in sheltered sites[9-12]. The species is divided in different geographic varieties, sometimes given the status of subspecies, and their classification is still under debate. Three main varieties are recognised: the Alpine larch (*Larix decidua* var. *decidua*), living in a compact area that includes the Alpine mountains continuing up to east Austria and northern Slovenia between 250 m (Austria) and 2 300 m (western Alps) of elevation; the Carpathian larch (*Larix decidua* var. *carpatica*) with three more patchy populations, in the Sudeten Mountains, the Tatra Mountains and in Southeast Carpathians, between 650 and 1 900 m in elevation; the Poland larch (*Larix decidua* var. *polonica*) with patchy often isolated stands growing in central-south Poland between 180 and 650 m[1, 4, 11]. The Carpathian and the Poland larches are often grouped together or divided in geographic subspecies by several authors[2, 11]. In north-western Europe (Great Britain, Scandinavia) larches have been widely cultivated since 16th century and naturalised in some cases[1, 12, 13]. More recently, these plantations have been largely superseded first by the Japanese larch (*Larix kaempferi*) or Siberian larch (*Larix sibirica*) and then by larch hybrids (i.e. *Larix* x *marschlinsii*)[2]. The European larch was also introduced in southern Canada and the north-eastern United States from the mid-19th century[14, 15], and in New Zealand, where it is classified as a naturalised and invasive species[16].

Habitat and Ecology

The European larch is a light-demanding, pioneer species of the mountain and subalpine regions. This conifer has a large ecological amplitude. In the Alps and Tatra Mountains it grows in continental climates, with cold, dry and snowy winters. In Poland and in the Sudeten Mountains larch thrives at lower altitudes in sub-continental climates with a more temperate influence [1, 11]. It needs light in all stages of development, colonising disturbed soils (avalanches, landslide, livestock grazing, etc.) and forming open woodlands[1]. In lower elevations it is a transitional tree, performing as coloniser better than other mountain tree species in poor to medium nutrient sites[8, 17], while in the subalpine belt it forms more stable forests in pure or mixed stands[10]. It grows on well-drained soils, not tolerating waterlogging, with a pH range from neutral to acid[12]. The larch is very cold and wind tolerant during winter (dormant period), and it has a cold hardiness limit of around -30 °C[18]. Its deciduous habit confers a significant advantage by reducing desiccation damage on foliage during winter[8]. In the Alps at higher elevations larch forms the upper tree limit, occurring in pure forests in the Italian, French and Southern Swiss Alps, while farther north this species is more often found in mixed stands with other alpine tree species, principally the Swiss stone pine (*Pinus cembra*), but also green alder (*Alnus viridis*) and dwarf mountain pine (*Pinus mugo*). In the lower elevations it can be found with Norway spruce (*Picea abies*) and silver fir (*Abies alba*), while lower down with beech (*Fagus sylvatica*) on poor soils and in open and disturbed areas[4, 9, 10, 15]. In the Carpathian Mountains larch occurs usually with Norway spruce and Swiss stone pine or Scots pine (*Pinus sylvestris*), and also with fir and beech. It only sporadically



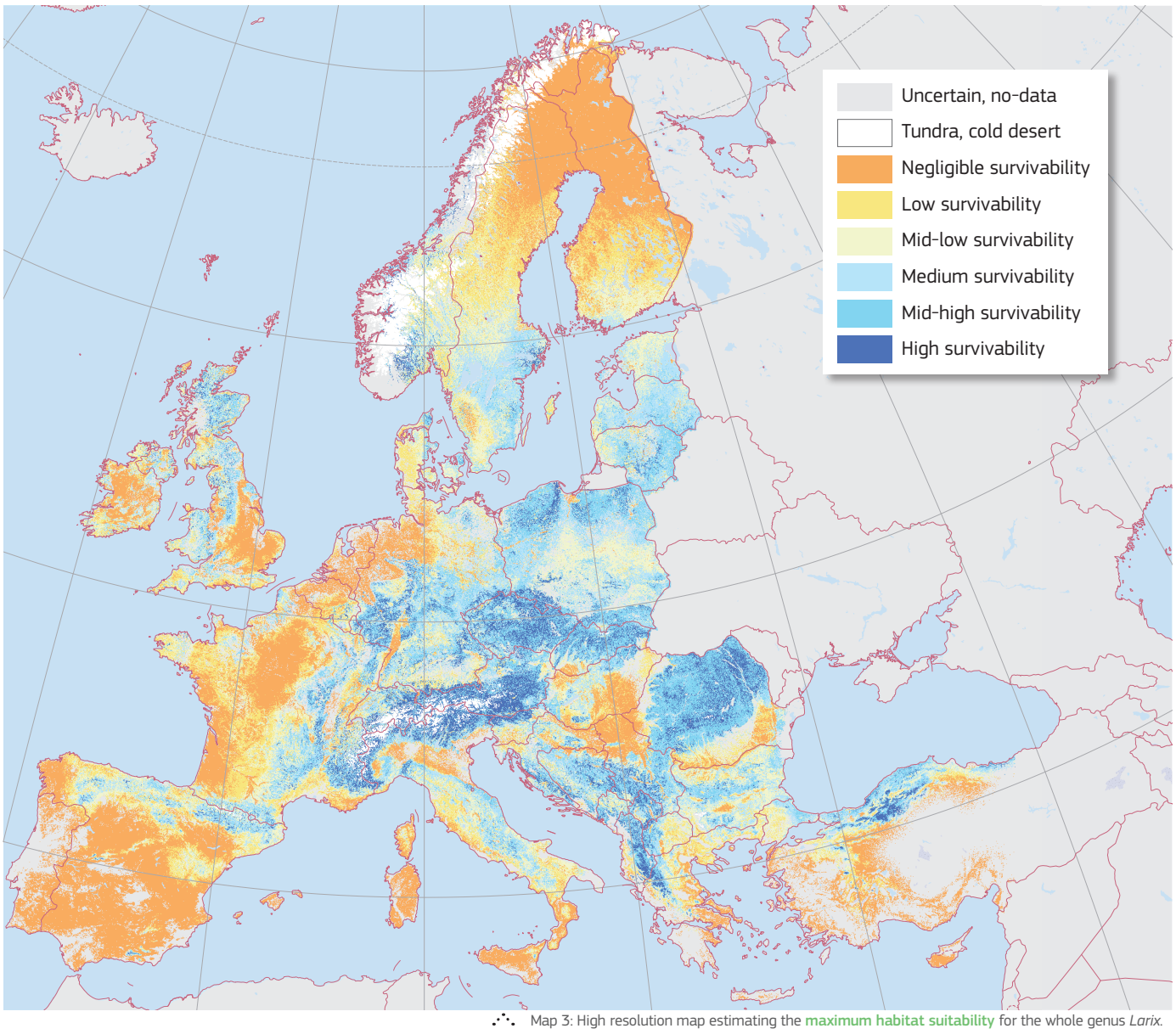
Map 2: High resolution distribution map estimating the **relative probability of presence** for the whole genus *Larix*.

Large isolated larch; this tree can in some cases grow to over 50 m.

forms the timberline belt, typically in the High Tatra Mountains with Swiss stone pine, a vegetation similar to Alpine larch woods[1, 19-21]. In Poland it occurs in lowlands growing in small groups or even as individual trees within pine-birch and oak-birch forests[1, 21, 22]. These ecotypes are less light demanding and able to grow in the shade of other tree species[11].

Importance and Usage

The larch is an economically and traditionally important timber tree in Europe, thanks to its fast-growing nature, high adaptability and its durable wood[8]. The heartwood ranges from yellow to a medium reddish brown. The narrow sapwood is nearly white or pale yellow and is clearly demarcated from the heartwood. The wood is hard, strongly fragrant and is valued for its durability, due to its concentration in tannins (up to 10%) and resin content (about 2.6%)[1]. It is also durable under water. In fact it is largely used for carpentry and naval constructions[8]. In the European mountain areas its wood has been traditionally used for building wooden houses[23], for producing furniture and fine floors and many weatherproof outdoor objects such as fences, gates, benches and tables, wooden roof shingles and water troughs for cattle[11]. Moreover, larch is used for pulpwood and its good fibre characteristics (also for high-quality printing paper[23]), for extracting tannin from bark and resin from wood, and also as an ornamental tree, appreciated for airy foliage turning to bright yellow in autumn[8]. The larch **turpentine**, also known as Venice turpentine, is obtained by distillation of larch resin and it has been used in traditional medicine as antitussive and expectorant action for colds, and more recently as industrial solvent, for paint and wax preparation, or as a source of organic compounds (e.g. camphor, rosin, etc.). The larch essential oil is still used in aromatherapy and as perfume[1]. In some Alpine areas larch wood is still used to manufacture the Alphorn, a wooden horn, 3-4 m long, end-curved, played with its end resting on the ground, which is able to produce very low and strong notes with great effort from the musician. It was originally used in central European Alps for communications among village communities through the valleys; now it is a traditional Alpine instrument[24,25].



Map 3: High resolution map estimating the **maximum habitat suitability** for the whole genus *Larix*.

Leaves turn to yellow in autumn before falling: the only deciduous European conifer.
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Adult plant has thick and plated greyish bark with deep fissures.
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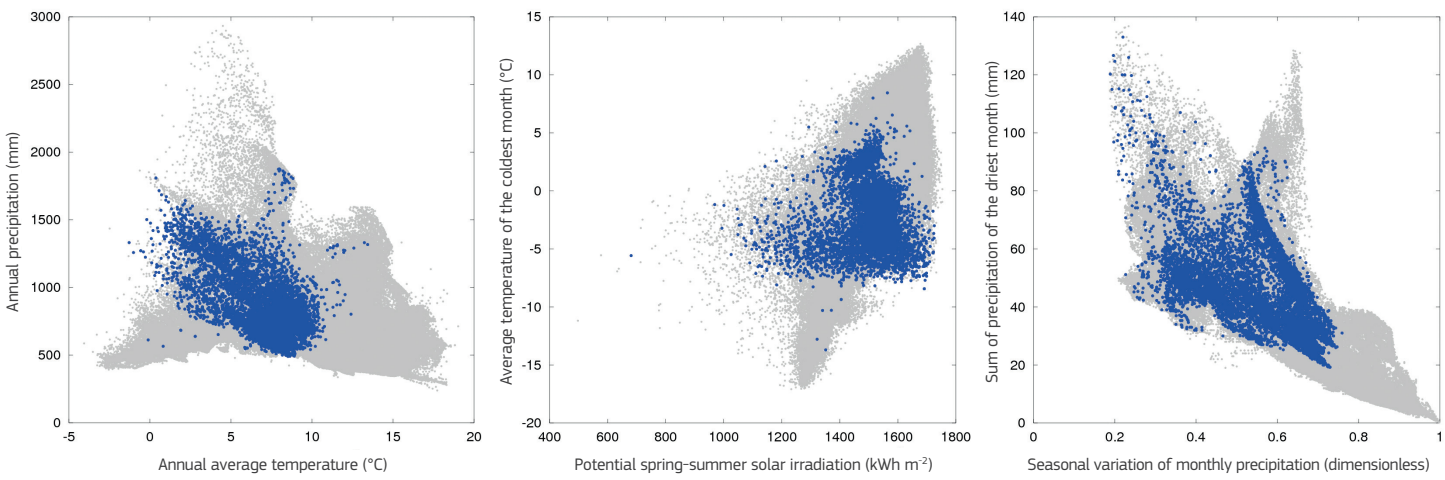

Autoecology diagrams based on harmonised **field observations** from **forest plots** for *Larix decidua*.

Maturing seed cones; they can persist on the tree up to 10 years.
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Larix decidua

Other larches in Europe

The Siberian or Russian larch (*Larix sibirica* Ledeb.) has a wide range along Eurasia, from the coasts of White Sea in northern European Russia, through Siberia up to Baikal Lake, northern Mongolia and China[6]. It is common tree of lowland taiga in western Siberia, but also occurring in mountain areas. It forms the northern tree limit and occurs in pure and, more often, mixed forests[4]. It can be distinguished by the European larch for its green seed cones densely pubescent outside[4, 39]. It is adapt to cold and dry continental or sub-arctic climates. In Russia this larch is an important timber tree, logged in natural strands and also in plantations outside its natural range. Its strong and durable wood was traditionally used for Siberian house construction and for rail sleepers of the Trans-Siberian Railroad. Actually it is used for construction, veneer and pulp industry, successfully planted in Scandinavia, Iceland, central and eastern Europe[4]. It does not overlap and hybridise naturally with the European larch[2]. In Europe the Japanese larch (*Larix kempferi* Lamb.) is another important timber tree for wood production. It is native of a small mountain region on the Hondo Island in Japan, which includes the Mount Fuji[40]. It has been introduced in Scotland in mid of 19th century and later in many European countries, appreciated for its fast growth and great production in different types of soils[4, 6]. Leaves shows two white stomatal bands beneath and seed cones are characterised by scales with apex recurved margins, curling back[2, 39]. This larch is adapt to more oceanic climates with rainy summers[11]. Its wood is similar to the European larch, and it has been used for construction, railway sleepers, pit props and pulp industry. Hybrids with the European larch naturally arose in the first years of 20th century in Scotland and Switzerland, and have been named Dunkeld larch (*Larix* x *marschlinsii*, syn. *Larix* x *eurolepis*)[2, 11, 12]. They have showed superior vigour in growth to either parents, so foresters have been propagated and planted in many countries, principally in central Europe[4].

[Top Left] Siberian larches in Ural Mountains near Saranpaul (Tyumen region, Russia). [Bottom left] Seed cones and autumn foliage of the hybrid Dunkeld larch (*Larix* x *marschlinsii*). [Right] Japanese larches (*Larix kempferi*) by the Lake Ozenuma in Oze National Park (Fukushima, Japan).
(Copyright [top left] Irina Kazanskaya, www.flickr.com, [bottom left] Carl Mueller, www.flickr.com, [Right] Tanaka Juuyoh, commons.wikimedia.org: CC-BY)

Threats and Diseases

While the larch heart-root system may offer a good resistance to windthrow[26], the species appears less resistant to rockfall[26, 27] even if the thick bark may offer a lower rockfall-mortality rate when compared with spruce[26]. Larches are vulnerable to *Ips typographus* and to other species of the *Ips* genus, such as *Ips cembrae*. These bark beetles are also associated as vectors of important fungal pathogens[28-32]. The larch canker, caused by *Lachnellula wilkommii*, is a fungal disease, which causes cankers distorting branches and stems. It is considered the most destructive disease of the larch in Europe, particularly at lower altitudes and on inadequate, badly drained sites[8]. Other fungal diseases are the leaf cast fungus, *Meria laricis*, which may cause significant defoliation, the root rot *Heterobasidion annosum*[12] and the velvet-top fungus *Phaeolus schweinitzii* causing butt rot. Defoliations, sometimes heavy, can be imposed by insects such as the larch case-bearer (*Coleophora laricella*) or the larch bud moth (*Zeiraphera diniana*). Tree deaths caused by the defoliators are rare events, but infested larch stands suffer, resulting in significant growth reductions and economic losses[33, 34]. The European larch is vulnerable to *Dothistroma septosporum*[30, 35]. The large pine weevil (*Hylobius abietis*) is among the most serious pests affecting young coniferous forests in Europe[36, 37]. Larch partly coexists with the natural niche of the large pine weevil[36]. The Poland larch occurs in ancient small stands, even as solitary old trees, surrounded by different broadleaves in strong competition. Probably in the past the forest management promoted larch presence with more open woodlands where the larch regeneration was guaranteed. Today larches are mostly in forest reserves and are no longer logged, leading through succession to different forest types[38].

Needle-like leaves in spring: they are arranged in clusters of 20-40 in the branchlets.
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Reddish female flower before pollination.
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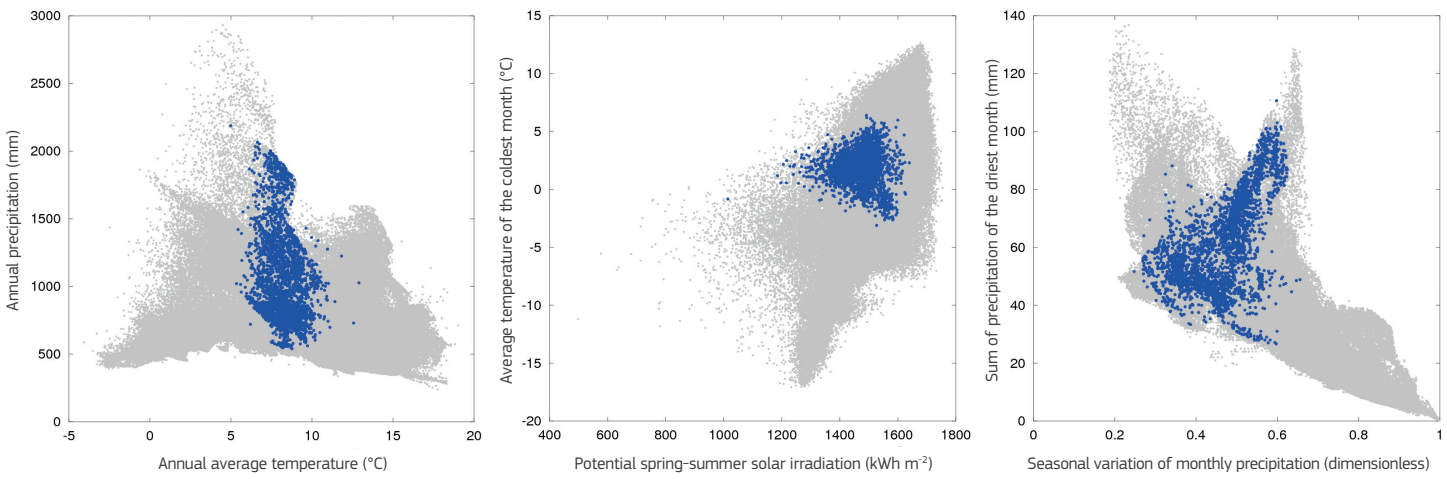
Field data in Europe (including absences) ● Observed presences in Europe ●

Autoecology diagrams based on harmonised field observations from forest plots for *Larix kempferi*.



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